

**WHAT IS CLAIMED IS:**

- 1           1.       A method of operating a network, the network comprising:  
2           a plurality of nodes connected by a plurality of optical links, comprising  
3           provisioning a virtual path between a first node and a second node of  
4           said plurality of nodes, wherein provisioning comprises:  
5           identifying said first node and said second node of said plurality of  
6           nodes,  
7           discovering a physical path from said node to said second node by  
8           automatically identifying any intermediary nodes of said  
9           physical path, and  
10          establishing said virtual path by configuring a set of connections  
11          between said nodes of said physical path.
- 1           2.       The method of claim 1, further comprising:  
2           testing said virtual path by testing each one of said plurality of nodes and said  
3           plurality of links in said physical path as a single circuit.
- 1           3.       The method of claim 1, further comprising:  
2           allocating intermediary links between said first, said second and said  
3           intermediary nodes.
- 1           4.       The method of claim 3, further comprising:  
2           terminating said virtual path by automatically deallocating said intermediary  
3           links.
- 1           5.       The method of claim 4, wherein said intermediary links are available  
2           for re-use upon deallocation.
- 1           6.       The method of claim 3, further comprising:  
2           terminating said virtual path by sending a termination message from one of  
3           said first and said second nodes to the other of said first and said

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second nodes, wherein said termination message is sent along said physical path and each one of said intermediary links is deallocated by a respective one of said nodes as said termination message is sent to each of said nodes.

7. The method of claim 6, wherein said intermediary links are available for re-use upon deallocation.

8. The method of claim 6, wherein said intermediary links are deallocated substantially simultaneously upon reception of a broadcasted termination message.

9. The method of claim 1, further comprising:  
restoring said virtual path in response to a failure along said physical path by:  
discovering an alternate physical path from said first node to said second node by automatically identifying intermediary nodes of said alternate physical path, and  
re-establishing said virtual path by configuring a set of connections between said nodes of said alternate physical path.

10. The method of claim 9, wherein at least one of said intermediary nodes of said physical path is also one of said intermediary nodes forming said alternate physical path.

11. The method of claim 1, further comprising:  
sending messages to maintain knowledge of a topology of the network and to determine if neighboring nodes have failed.

12. The method of claim 11, wherein each one of said plurality of nodes obtains information on neighboring ones of said plurality of nodes such that each one of said plurality of nodes is able to maintain a database representing a topology of the network.

1 13. The method of claim 12, wherein use of said database in said  
2 discovering said physical path allows said discovering said physical path to proceed  
3 more quickly.

1 14. A method of restoring a virtual path in an optical network, said virtual  
2 path being provisioned on a physical path between a first and a second node of the  
3 optical network, the optical network comprising a plurality of nodes connected by a  
4 plurality of links, the method comprising:

5 discovering an alternate physical path from said first node to said second node  
6 by automatically identifying nodes of said alternate physical path, and  
7 re-establishing said virtual path by configuring a set of connections between  
8 said nodes of said alternate physical path.

1 15. The method of claim 14, wherein said discovering and said re-  
2 establishing are performed in less than one second.

1 16. The method of claim 14, wherein said discovering and said re-  
2 establishing are performed in less than 200ms.

1 17. The method of claim 14, wherein said discovering and said re-  
2 establishing are performed in less than 50 ms.

1 18. The method of claim 14, wherein said virtual path is restored in  
2 response to a failure along said physical path, the method further comprising:  
3 detecting said failure, wherein said detecting, said discovering, and said re-  
4 establishing are performed in less than one second.

1 19. The method of claim 14, wherein said virtual path is restored in  
2 response to a failure along said physical path, the method further comprising:  
3 detecting said failure, wherein said detecting, said discovering, and said re-  
4 establishing are performed in less than 200 ms.

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1        20.     The method of claim 14, wherein said virtual path is restored in  
2 response to a failure along said physical path, the method further comprising:  
3        detecting said failure, wherein said detecting, said discovering, and said re-  
4        establishing are performed in less than 50 ms.

1        21.     The method of claim 14, wherein each one of said plurality of nodes  
2 obtains information on neighboring ones of said plurality of nodes such that each one  
3 of said plurality of nodes is able to maintain a database representing a topology of the  
4 optical network and use of said database in said discovering said alternate physical  
5 path allows said discovering to otherwise proceed more quickly.

1        22.     The method of claim 14, wherein at least one of said nodes of said  
2 physical path is also one of said nodes of said alternate physical path.

1        23.     A method of operating an optical network, the optical network  
2 comprising a plurality of nodes connected by a plurality of links, wherein each one of  
3 said plurality of nodes obtains information on neighboring ones of said plurality of  
4 nodes such that each one of said plurality of nodes is able to maintain a database  
5 representing a topology of the optical network.

1        24.     A method of operating an optical network, the optical network  
2 comprising a plurality of nodes connected by a plurality of links, comprising:  
3        for each one of said plurality of nodes:  
4                obtaining information from neighboring nodes, said information  
5                regarding a state of at least one of said plurality of links, and  
6                using said information to maintain a database representing a topology  
7                of the optical network.

1        25.     A method of testing a virtual path in an optical network, said virtual  
2 path provisioned on a physical path between a first and a second node of said optical

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3 network, said network comprising a plurality of nodes connected by a plurality of  
4 links, comprising:

5 testing said virtual path by testing each one of a plurality of nodes and a  
6 plurality of links in said physical path as a single circuit.

1 26. A computer program product encoded in computer readable media, the  
2 computer program product comprising:

3 first instructions, executable by a first processor, for identifying a first node  
4 and a second node of a plurality of nodes, said plurality of nodes being  
5 coupled by a plurality of links to form an optical network;

6 second instructions, executable by said first processor, for discovering a  
7 physical path from said first node to said second node by automatically  
8 identifying intermediary nodes of said physical path; and

9 third instructions, executable by said first processor, for establishing said  
10 virtual path by causing a second processor to configure a set of  
11 connections between said nodes of said physical path.

1 27. The computer program product of claim 21, further comprising a  
2 graphical user interface for displaying a topology of said optical network.

1 28. The computer program product of claim 26, further comprising:  
2 fourth instructions, executable by said first processor, for testing said virtual  
3 path by testing each one of said plurality of nodes and said plurality of  
4 links of said physical path as a single circuit.

1 29. The computer program product of claim 26, further comprising:  
2 fourth instructions, executable by said first processor, for terminating said  
3 virtual path by sending a termination message from one of said first  
4 and second nodes to the other of said first and second nodes, wherein  
5 said termination message is sent along said physical path and each one  
6 of said intermediary nodes is deallocated by a respective one of said

7 nodes forming said physical path as said termination message is sent to  
8 a next one of said nodes.

1 30. The computer program product of claim 26, further comprising:  
2 fourth instructions, executable by said first processor, for restoring said virtual  
3 path in response to a failure along said physical path by discovering an  
4 alternate physical path from said first node to said second node by  
5 automatically identifying nodes forming said alternate physical path,  
6 and re-establishing said virtual path by configuring a set of connections  
7 between said nodes of said alternate physical path.

1 31. The computer program product of claim 21, wherein the computer  
2 readable media includes any of magnetic storage media, including disk and tape  
3 storage media; optical storage media, including compact disk memory and digital  
4 video disk storage media; nonvolatile memory storage memory; volatile storage  
5 media; and data transmission media including computer network, point-to-point  
6 telecommunication, and carrier wave transmission media.

1 32. A computer system comprising:  
2 a display device;  
3 a processor coupled to the display device;  
4 computer readable medium coupled to the processor; and  
5 computer code, encoded in the computer readable medium, for generating a  
6 graphical user interface, wherein the graphical user interface includes a  
7 first plurality of screen objects representing nodes of an optical  
8 network, a second plurality of screen objects representing optical links  
9 between said nodes, wherein:  
10 a first one and a second one of said first plurality of screen objects are  
11 highlighted to indicate a source node and a destination node,  
12 respectively, and  
13 certain ones of said first plurality of screen objects and certain ones of  
14 said second plurality of screen objects are highlighted by said

15 computer code to indicate a virtual path selected by said  
16 computer code.

1 33. An optical network comprising:  
2 a plurality of optical links;  
3 a plurality of nodes, each one of said plurality of nodes coupled to at least one  
4 other of said plurality of nodes by at least one of said plurality of  
5 optical links, wherein said nodes are configured to provision a virtual  
6 path between a first node and a second node of said plurality of nodes  
7 by virtue of being configured to:  
8 identify said first node and said second node of said plurality of nodes,  
9 discover a physical path from said node to said second node by virtue  
10 of being configured to automatically identify any intermediary  
11 nodes of said physical path, and  
12 establish said virtual path by virtue of being configured to configure a  
13 set of connections between said nodes of said physical path.

1 34. An optical network comprising:  
2 a plurality of optical links;  
3 a plurality of nodes, each one of said plurality of nodes coupled to at  
4 least one other of said plurality of nodes by at least one of said  
5 plurality of optical links, wherein said nodes are configured to  
6 restore a virtual path in said optical network, said virtual path  
7 being provisioned on a physical path between a first and a  
8 second node of said plurality of nodes by virtue of being  
9 configured to:  
10 discover an alternate physical path from said first node to said  
11 second node by virtue of being configured to  
12 automatically identify nodes of said alternate physical  
13 path, and

14 re-establish said virtual path by virtue of being configured to  
15 configure a set of connections between said nodes of  
16 said alternate physical path.

1 35. A network comprising:  
2 a plurality of nodes connected by a plurality of optical links, wherein said  
3 plurality of nodes are configured to provision a virtual path between a  
4 first node and a second node of said plurality of nodes, wherein each of  
5 said plurality of nodes comprises:  
6 identifying means for identifying said first node and said second node  
7 of said plurality of nodes,  
8 discovering means for discovering a physical path from said node to  
9 said second node by automatically identifying any intermediary  
10 nodes of said physical path, and  
11 establishing means for establishing said virtual path by configuring a set of  
12 connections between said nodes of said physical path.

1 36. The network of claim 35, wherein said each one of said plurality of  
2 nodes further comprises:  
3 restoring means for restoring said virtual path in response to a failure along  
4 said physical path comprising:  
5 alternate discovering means for discovering an alternate physical path  
6 from said first node to said second node by automatically  
7 identifying intermediary nodes of said alternate physical path,  
8 and  
9 re-establishing means for re-establishing said virtual path by  
10 configuring a set of connections between said nodes of  
11 said alternate physical path.

1 37. An optical network comprising:  
2 a plurality of nodes connected by a plurality of optical links, wherein said  
3 plurality of nodes are configured to restore a virtual path in an optical



